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## A REVISION OF THE GENUS *PTERIDIUM*

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(Plates 650–653)

### INTRODUCTION

THE only species of the monotypic genus *Pteridium*, *P. aquilinum*, is one of the most familiar plants in the world. Its distribution is world-wide in temperate and tropical regions and it is common to the point of becoming a weed in most of the regions in which it grows. Many authors complain of its weedy character in the British Isles, northwestern United States and New Zealand. In these regions and probably in others it invades fields and most especially pastures and it is probably the most obnoxious native weed with which the farmers have to deal. Apparently, it immediately assumes the role of a weed as soon as man tries to turn to his own uses any land that it finds suitable for its growth. However, the weedy character seems to vary with the variety, or region, for var. *latiusculum* and var. *pseudocaudatum* in eastern North America only rarely, if ever, become a serious menace to farmers.

Among the many species of ferns that spread by means of rhizomes or runners, the Bracken is particularly well adapted to the role of a weed. In favorable soil conditions there is a widely creeping, deep, main rhizome from which lateral, ascending branches arise. These branches usually rebranch and produce



the fronds fairly near the surface. A dormant bud is produced at the base of each frond so that each year the plant has a potential second set of fronds. If, through burning or plowing, the lateral branches are destroyed, the main deep-seated rhizome can continue the life of the plant.

A few excerpts from a recent article on the Bracken in Britain<sup>1</sup> will illustrate its economic importance as a weed and some of the methods taken to control it. "Bracken ranks as the most plentiful and widespread of British ferns. It is generally distributed in most rough grazings and in many old permanent pastures in almost every part of Britain. It is plentiful in most open woodlands and on the sites of formerly wooded areas. . . . Many of the older writers have dealt with the loss of grazing due to Bracken. . . . 'I have seen the Roots of it in some Grounds, eight Foot deep. The best cure is often mowing of it while in grass. If you plow it up, plentiful dunging of it and Ashes are very good: but the certainest cure for it is Urine.' *J. Mortimer, The Whole Art of Husbandry, 2nd Ed., 1708.*" At the present time, the authors recommend cutting the fronds when they are fully mature and following this with heavy grazing; and also the use of phosphate and lime fertilizers to build up the ground and make it unsuitable for the growth of the Bracken. Sodium chlorate and sulphuric acid are recommended as killing sprays. "In closing this paper, however, the writers desire very definitely to record their view that the bracken menace has grown so rapidly, and has now attained such proportions, that it is of real national importance: at the International Grassland Congress of 1937 one speaker referred to it as 'the ghost stalking silently at our side, which nobody dares to discuss.' . . . A million pounds sterling devoted to the reduction of the area infested by bracken would be well spent."

Many species of fungi are parasitic upon *Pteridium aquilinum*<sup>2</sup> and attempts have been made to use them in its control. *Fusarium* sp. and *Corticium anceps* (Bres. and Syd.) Gregor have been tried<sup>3</sup> but due to the fact that the host seems to be

<sup>1</sup> Long and Fenton, The Story of the Bracken Fern. Journ. Royal Ag. Soc. Eng. **99**: 15-36 (1938).

<sup>2</sup> See Seymour, Host Ind. Fungi N. Am. (1929) and Faull, Gen. Urediniopsis. Contrib. Arn. Arb. **11** (1938).

<sup>3</sup> See Gregor in Verdoorn, Man. Pterid. 146 (1938).



more durable under varying environmental conditions than the fungus, they have not met with success.

To compensate for its economic liabilities, the Bracken has made itself available for many uses, though at the present time none are of real importance. The fronds have been used for stock-food, when mixed with grass; as silage; for packing fruits; in the place of hops in brewing; medicinally; in glass making and as litter for both man and stock. The fronds and rhizomes have been used in thatching and the green fronds burned as a source of potash. Nakai<sup>4</sup> says that in Java the fronds are laid on racks over the *Cinchona* beds to protect the young plants from the sun and that: "This shelter is not liable to rotten and decays harmoniously with the growth of the *Cinchona*. When *Cinchona* reaches to the height of the roof, it want the shelter no more, and the fronds are so good and perfect as they then become bones only, dropping all of the leaves." The rhizomes have been used in brewing a beer and also as swine-food. It is reported that the swine prefer the rhizome plus soil. The hairs from the base of the petiole of var. *caudatum* are used for stuffing pillows and the fronds are used as packing in the tops of charcoal bags. A solution of the boiled fronds has been used effectively as a rose spray. Bracken is often accused of being poisonous to stock but apparently this is true only when it is eaten exclusively and in large amounts. The rhizomes, which contain a considerable amount of starch, have been used as food, at one time or another, in Switzerland, France, Canary Islands, western North America, Society Islands, New Zealand, Tasmania, New South Wales and China. It is said that formerly it was an important food-item of the Maoris of New Zealand. One doctor is reported as using the starch in place of arrowroot. However, the ordinary rhizome would undoubtedly be poor fare and probably was usually eaten only to stave off actual starvation. Forster<sup>5</sup> says that: "Radices ab incolis inopibus et famelicis exsuguntur, insipidae, parum nutrientes lignoso-fibrosae." The croziers have been used as "asparagus" in Japan and western North America. A number of botanists have reported eating the broiled croziers and say the flavor is quite agreeable. I can

<sup>4</sup> Nakai, Critical Notes on Japanese Ferns. Bot. Mag. Tokyo 39: 110 (1925).

<sup>5</sup> Forster, Pl. Escul. 74 (1786).



attest this myself but must add that the dense pubescence is rather troublesome.

In the Canary Islands, *Orobanche trichocalyx* (Webb & Berth.) G. Beck and *O. Schultzii* Mut. are parasitic upon *Pteridium aquilinum*.

#### REPRODUCTION

Vegetative propagation by means of the creeping rhizome is the predominate method of reproduction of the Bracken, although in favorable localities ordinary sexual reproduction is quite as effective. Although the Bracken habitually grows in rather dry places these are apparently not suitable for its normal reproduction, the prothallial stage developing only in relatively damp situations. Long and Fenton<sup>6</sup> say that in the eastern side of Britain, the prothallial stage is rare or unknown, while in the western side, where there is considerably more rainfall, young plants are not uncommon. In eastern North America young plants are only rarely seen. The young stages are not common as herbarium specimens. It is an indication of their relative rarity that at least two species and one variety have been described on the basis of young plants, although their authors no doubt little suspected they were redescribing the familiar Bracken. If, in the past, the Bracken has reproduced largely by vegetative means, this might well explain its present vigor and the lack of specific segregation within the genus. Judging biological age by the number of generations, it would still be a relatively young species.

#### NECTARIES

Nectaries are present at the base of the lower pinnae. These were apparently first noticed by Charles and Francis Darwin<sup>7</sup> but they have been mentioned by few authors<sup>8</sup> since then. I had an opportunity to observe them on var. *latiusculum* in the Harvard University Botanic Garden in the spring of 1940. On the sixth of May, the basal pinnae were just starting to unroll and

<sup>6</sup> *Op. cit.*

<sup>7</sup> Francis Darwin, Journ. Linn. Soc. 15: 407, Tab. 6, Fig. 6 (1876).

<sup>8</sup> The only other original observation I have seen is that of Victorin, Les Filicinées du Québec. Contrib. Lab. Bot. Univ. Montréal No. 2, 71 (1923), who says: "Au printemps les nectaires basilaires des segments sont presque toujours visités par une grosse fourmi noire."



the nectaries were clearly visible at the base of the pinnae as dark brown, smooth, somewhat swollen areas on the dorsal side of the then densely pubescent rachis. As the fronds continued to unroll proportionately smaller nectaries could be seen at the base of the second and third pair of pinnae. These nectaries were functional in that they exuded a liquid in the form of droplets from small pores. The nectaries at the base of the second pair of pinnae were not as active as those below and those at the base of the third pair of pinnae seemed to be entirely inactive. Large red and black ants were attracted by the exudation and observed in considerable numbers feeding upon it. Although an analysis was not made, the fact that ants feed upon the liquid undoubtedly indicates that it contains sugar. A free-hand section of the nectary area showed parenchymatous tissue but there was no evidence of glands. For these reasons I think it is likely that the exudation is neither a guttation of nearly-solute-free water nor a modified secretion but rather an excretion of the stipe-sap. The nectaries are active in the sun and also in the shade. They were quite active on a cloudy humid day. They were observed to remain active until the fronds were almost completely unrolled and may be active for a longer period of time. By midsummer they have become quite insignificant and entirely inactive. I believe this phenomenon is physiological, perhaps related to root pressure.

#### PRIMITIVE AND ADVANCED CHARACTERS

Phylogenetically considered, *Pteridium* has a curious combination of relatively primitive external characters and relatively advanced internal characters. In the *Pteridoideae* it is considered to be a primitive genus<sup>9</sup> on the basis of the following characters: presence of a more or less vestigial inner indusium; initial basipetal succession of sporangia; hairs, but no scales, present on the rhizome; equal dichotomy of the axis in its early development; and open venation. On the other hand, the highly developed vascular structure of the stem and petiole and the presence of true vessels<sup>10</sup> indicate an advanced condition. The highly developed internal structure, however, is undoubtedly, at least in part, related to the relatively large size of the plant.

<sup>9</sup> See Bower, *The Ferns*. 3: 41-45 (1928).

<sup>10</sup> Bliss, *The Tracheal Elements in the Ferns*. *Am. Journ. Bot.* 26: 620-624 (1939).



## HISTORICAL ACCOUNT

Most of the taxonomic work on the Bracken has been done by authors working in a limited area or on a limited number of forms. There have been only a few comprehensive treatments. This has resulted in a general tendency to treat the various groups as species and to recognize, in one rank or another, trivial variations, a condition which naturally has led to a multiplicity of names. Not only has it been unnecessary to describe any new varieties in the present treatment, but in 1839 Agardh likewise found all of the groups he recognized already named. Most of the critical work has been done by local authors.

As in the case of so many groups, Linnaeus, Sp. Pl. 2 (1753), laid the foundations for the present treatment. He recognized, in the genus *Pteris*, two species, *P. aquilina* and *P. caudata*, which represent the ssp. *typicum* and *caudatum* of this treatment. Willdenow, Sp. Pl. 5 (1810) recognized, besides *Pteris aquilina* and *P. caudata*, some additional species described since 1753: *P. capensis*, *P. esculenta* and *P. lanuginosa*. Under *P. aquilina* he recognized, in var.  $\beta$ , a combination of var. *latiusculum* and var. *pseudocaudatum* of this treatment, but most later authors did not take up this segregate.

Agardh, Rec. Pterid. (1839) was the first author really to study material from most of the regions of the world and his treatment is in close agreement with the present one although he regarded most of the groups as species. He followed Linnaeus in treating the Brackens under the genus *Pteris*, but set them apart from the other species as the section *Ornithopteris*. He recognized *P. esculenta*, *P. arachnoidea*, *P. caudata* and *P. decomposita* and applied the names in essentially the same sense as in the present treatment. In *P. semihastata* and *P. recurvata* he recognized, respectively, var. *yarrabense* and var. *Wightianum*. Under *P. aquilina* he mentioned, but did not describe, var. *pseudocaudatum*. In the main his treatment differs from the present one only in the recognition of *P. lanuginosa* and in uniting var. *latiusculum* with *P. aquilina*. Later authors would have done well to follow Agardh's treatment more closely.

Hooker, Sp. Fil. 2 (1858) presented the next, and really the last, comprehensive treatment of the genus. He followed Agardh in treating the species under section *Ornithopteris* of *Pteris*, but



except for *P. coriifolia* and *P. psittacina*, which he says he did not understand, having seen no specimens, he reduced all names under *P. aquilina* and recognized only varieties. The present treatment agrees with his in this respect, but his varietal lines were rather poorly drawn. All varieties in the present ssp. *typicum* he treats under var. *glabra*, fronds glabrous or nearly so beneath, and var. *lanuginosa*, fronds quite pubescent beneath. In the present ssp. *caudatum* he recognized var. *caudata*, applying it in the present sense, and var. *esculenta*, including the present var. *esculentum*, var. *arachnoideum* and var. *yarrabense*. This treatment was long followed and led especially to a confusion of var. *esculentum* of Polynesia, Australia and New Zealand and var. *arachnoideum* of South America.

Diels, Nat. Pfl. 1<sup>4</sup> (1899) and Christensen, Ind. Fil. (1905) recognized the single species *Pteridium aquilinum*. Nakai, *op. cit.* (1925) in a rather rambling and non-critical discussion, made several new combinations under *Pteridium*, reviewed much of the literature and discussed the status of various species and varieties.

Under various names, Scopoli, Fl. Carn. (1760), Gleditsch, Syst. Pl. (1764), Newman, Phytol. 2 (1845) and John Smith, Hist. Fil. (1875) separated the present genus *Pteridium* from *Pteris*, but it was not until Kuhn in v. d. Decken, Reis. Ost.-Af. 3<sup>3</sup> (1879) took up and defined *Pteridium* that the Brackens were widely treated as a distinct genus.

#### TERMINOLOGY

Certain terms have been used in the descriptions in a strictly limited sense and certain unusual terms and characters have been used. These are explained below:

The *vernation* of the frond *equal*, all of the pinnae becoming unrolled at essentially the same time; *subgleichenioid*, the tips of the upper pinnae still inrolled while the lower pinnae are completely unrolled; or *gleichenioid*, the basal pinnae being completely unrolled while the third or fourth pair of pinnae are completely inrolled.

A *costa* is the midnerve of a pinna.

A *costule* is the midnerve of any segment of lesser order than a pinna, with the exception of the midnerve of the ultimate segments, which is called the *midnerve*.



In some varieties there are lunate or sublunate, entire lobes along part of the rachis, costae and costules, between the divisions of the blade. These are called *free lobes*. PLATE 650, FIG. 10.

The *ultimate segments* are *adnate*, broadest, but not dilated, at the base (PL. 650, FIG. 7); *decurrent*, dilated at the base toward the base of the midnerve (PL. 650, FIG. 16); *surcurrent*, dilated at the base toward the tip of the midnerve (PL. 650, FIG. 3); or *narrowed* at the base (PL. 650, FIG. 6).

The *upper surface* of the ultimate segments includes the midnerve but excludes the margin.

The *margin*, although morphologically on the upper surface of the segment, is described separately. It is the chlorophyll-bearing tissue closest to the base of the outer indusium.

Peculiar, irregular, wing-like epidermal outgrowths occur on the veins and midnerve on the lower surface of the ultimate segment in some varieties. These are called *membranous wings*. PLATE 650, FIG. 14.

Some varieties have a *farinaceous appearance* on the lower surface of the ultimate segments. This is a minute epidermal outgrowth, occurring between the veins, which, under high magnification, resembles a sparsely branched coral fungus. It may be an excretion but it is not affected by alcohol or dilute acid. PLATE 650, FIG. 13.

The term indusium is applied to the outer, functional indusium, the modified margin of the segment. The outer indusium is present in both fertile and sterile fronds and throughout partially fertile fronds. If it covers sporangia it is spoken of as the *fertile indusium*, if not, as the *sterile indusium*. The inner indusium is non-functional and usually nearly obsolete. When the inner indusium is meant it is called such.

The costules and lower side of the midnerves in ssp. *caudatum* are described as pubescent with white, dark or bicolorous hairs. The *white hairs* are long, thin, terete, whitish, multicellular hairs with oblique cross-walls. These are essentially of the same type that occur on the tissue on the lower surface of the segments. The *dark hairs* are rather large, stout, dark or reddish brown, usually terete, multicellular hairs with straight cross-walls, which are similar to those that occur on the rhizome. As these mature they often become moniliform, with whitish walls, only the septae



remaining brown. These are called *bicolorous hairs*. When one of these dark or bicolorous hairs breaks off, it often leaves a swollen base that is dark reddish brown and has the appearance of a sessile gland.

#### SYSTEMATIC TREATMENT

Although *Pteridium* is world-wide in distribution and the various populations show very strong phytogeographic affinities, and although it is undoubtedly a rather old genus, three lines of evidence lead me to believe that specific segregation has not taken place. First, in all areas where two varieties of the same subspecies overlap in range intermediate specimens are found (with the exception of var. *africanum* in ssp. *typicum*). Such intermediates are not common but they are of such frequency that, assuming indiscriminate rather than critical collecting, they must form a percentage of the *Pteridium* population of the area that cannot be overlooked. Second, in areas occupied exclusively by one variety, individuals, perhaps representing local populations, occur that have one or more characters of some other variety. That is, characters of one variety crop up occasionally in other varieties. In some cases a specimen will resemble another variety so closely that it would certainly be identified with it except by using the geographic "character." In other words, the critical characters of the varieties are not thoroughly stable. Third, the critical characters show little constancy within the group as a whole. That is, ciliation of the indusium in var. *Feei*, or non-ciliation in var. *africanum*, are critical characters but both conditions are commonly found in var. *caudatum*; pubescence on the undersurface of the blade in var. *pubescens* and the lack of it in var. *latiusculum* are critical characters, but var. *Wightianum*, while most commonly pubescent, is not infrequently nearly glabrous; pubescence on the margin of the segments in var. *Feei* and the lack of it in var. *typicum* are important characters, but var. *Wightianum* frequently exhibits both conditions; and the free lobes in var. *arachnoideum* and their absence in var. *caudatum* are diagnostic characters but both conditions are found in var. *yarrabense*. It seems to me that, when the critical characters of a group show such inconstancy, they are materially weakened for use in specific segregation.



The treatment of each variety follows a fixed order somewhat different from the conventional one. First, the accepted name and its synonymy and then any necessary discussion of the nomenclature. Second, the description of the variety followed by a discussion of taxonomic problems and a comparison with closely related varieties. Third, a short phytogeographic discussion, if desirable, a statement of habitat preference and a general statement of range. Last, a citation of specimens. In this arrangement, the critical discussion of nomenclature and taxonomic problems follows the synonymy and description, respectively; and the usually long citation of specimens comes at the end.

This study is based on the 2,500 sheets of *Pteridium* in the Gray Herbarium, the Herbarium of the New York Botanical Garden, the United States National Herbarium and the Herbarium of the Field Museum of Natural History.

#### DESCRIPTIONS

The critical characters in the descriptions have been italicised. The descriptions are based on mature specimens and do not take into account juvenile forms. The cutting of the blade is the same in the juvenile state of all varieties. The margins of the segments are flat, not revolute, and there is no sterile indusium. None of the various epidermal outgrowths are present except pubescence, and that is only weakly developed and not distinctive.

#### MAPS

The maps of the varieties have been compiled primarily from the cited specimens. These localities have been augmented by localities taken from other specimens examined and in a few cases by localities taken from the literature. These are used only when a specific locality was mentioned and where there was no doubt as to the identity of the variety. Localities based on specimens are indicated by a dot and those based on a printed record by a cross. The map of the species includes all of the localities on the varietal maps and in addition several localities taken from the literature where the identity of the variety was in doubt. On this map no distinction is made between localities based on specimens and those based on the literature. No attempt has been made to make the maps absolutely complete.



The series of specimens studied has in most cases been sufficient to plot the general range of each variety. The maps used have been selected from Goode's Series of Base Maps, Henry M. Leopold, Editor, Copyright by the University of Chicago, published by the University of Chicago Press.

#### CITATIONS OF SPECIMENS

The citations of specimens have been limited, when necessary, to two or three from each minor political division, i. e. state, province or department. The most widely distributed collections are cited in preference to the more locally distributed ones. Full citations are given in the discussions only for specimens that are not listed in the formal citations. Herbarium-sheet numbers, such as, Herb. Field Mus. no. 47805, are used in cases where the data on the label is insufficient to identify the specimen accurately. The usual abbreviations for the herbaria are used: F, for the Herbarium of the Field Museum of Natural History, Chicago, Ill.; G, for the Gray Herbarium, Harvard University, Cambridge, Mass.; NY, for the Herbarium of the New York Botanical Garden, Bronx Park, N. Y.; and US, for the United States National Herbarium, Smithsonian Institution, Washington, D. C. In the few cases where other herbaria are cited, abbreviations are not used.

#### ACKNOWLEDGEMENTS

I wish to thank Dr. P. C. Standley, Dr. H. A. Gleason and Dr. W. R. Maxon for the generous loan of material and for privileges extended at the herbaria under their care; and especially to express appreciation to Mr. C. A. Weatherby, without whose constant help and encouragement this study could scarcely have been completed.

#### SYSTEMATIC TREATMENT

*PTERIDIUM* Gled. ex. Scop. Fl. Carn. Ed. 1, 169 (1760), nomen abortivum(?); Kuhn in v. d. Decken, Reisen in Ost-Afrika 3<sup>3</sup>: 11 (1879).

*Pteris* L. Sp. Pl. 2: 1073 (1753), in part. *Filix* Ludwig, Instit. Hist. Ed. 2, 149 (1757), nomen dubium; sensu Woyнар, Hedwigia 56: 383 (1915). *Cincinalis* Gled. Syst. Pl. 290 (1764), emend Trevis. Atti Soc. Ital. sc. nat. 17: 239 (1875). *Asplenium* Bernh. Schrader's Journ. 1799<sup>1</sup>: 309 (1799), in part. *Allosorus* Bernh.



Schrader's neues Journ. **1**<sup>2</sup>: 36 (1806), sensu Pr. Tent. Pterid. 151 (1836), in part. *Paesia* St.-Hil. Voy. Brésil **1**: 381 (1833), sensu Moore, Gard. Chron. 878 (1858), in part. *Eupteris* Newm. Phytologist **2**: 278 (1845). *Ornithopteris* (Ag.) J. Sm. Hist. Fil. 297 (1875). *Aquilina* Pr. ex Diels in Engl. & Prantl, Nat. Pfl. **1**<sup>4</sup>: 296 (1899), in synonymy. *Filix-foemina* Farwell, Am. Mid. Nat. **12**: 290 (1931).

Although it is generally considered that Scopoli took up *Pteridium* Gled. for the Bracken, as a segregate genus from *Pteris* L., and it would therefore be the earliest valid generic name under the International Rules, some have argued that he proposed it as a substitute name for *Pteris* L. In order to meet this argument, *Pteridium* has been conserved (International Rules of Botanical Nomenclature, 131 (1935)).

*Rhizome* subterranean, extensively creeping, repeatedly branched, *invested with hairs but not scales*, the stele a perforated solenostele, true vessels present; *fronds alternate, large*; stipe relatively long, the *vascular bundles numerous*; *blade coarse*, pinnately divided, usually tripinnate, the lower pinnae with nectaries at the base; the segments very numerous, ovate to linear, the margin revolute; *veins free*; *sori marginal, mostly continuous*; *sporangia borne between the outer indusium, the modified margin of the segment, and the inner indusium*;<sup>11</sup> receptacle a vascular strand connecting the vein-ends, the inner indusium arising at its inner side; spores brown, very finely spinulose, tetrahedral-globose.—Represented by a single world-wide species, found in all temperate and tropical regions.

PTERIDIUM AQUILINUM (L.) Kuhn in v. d. Decken, Reisen in Ost-Afrika **3**<sup>3</sup>: 11 (1879). MAP 1. BRACKEN.

Characters of the genus.

KEY TO THE SUBSPECIES AND VARIETIES<sup>12</sup>

- a. Ultimate segments adnate, or equally decurrent and surcurrent, or surcurrent, or narrowed at the base, not having a farinaceous appearance beneath; pubescence of the lower surface lanuginose or absent. (ssp. *typicum*) b.
- b. Fertile and sterile indusium ciliate, or pubescent on the outer surface, or both; ultimate segments densely or sparsely pubescent beneath between the margin and the midnerve; pinnules nearly at right angles to the costae. c.

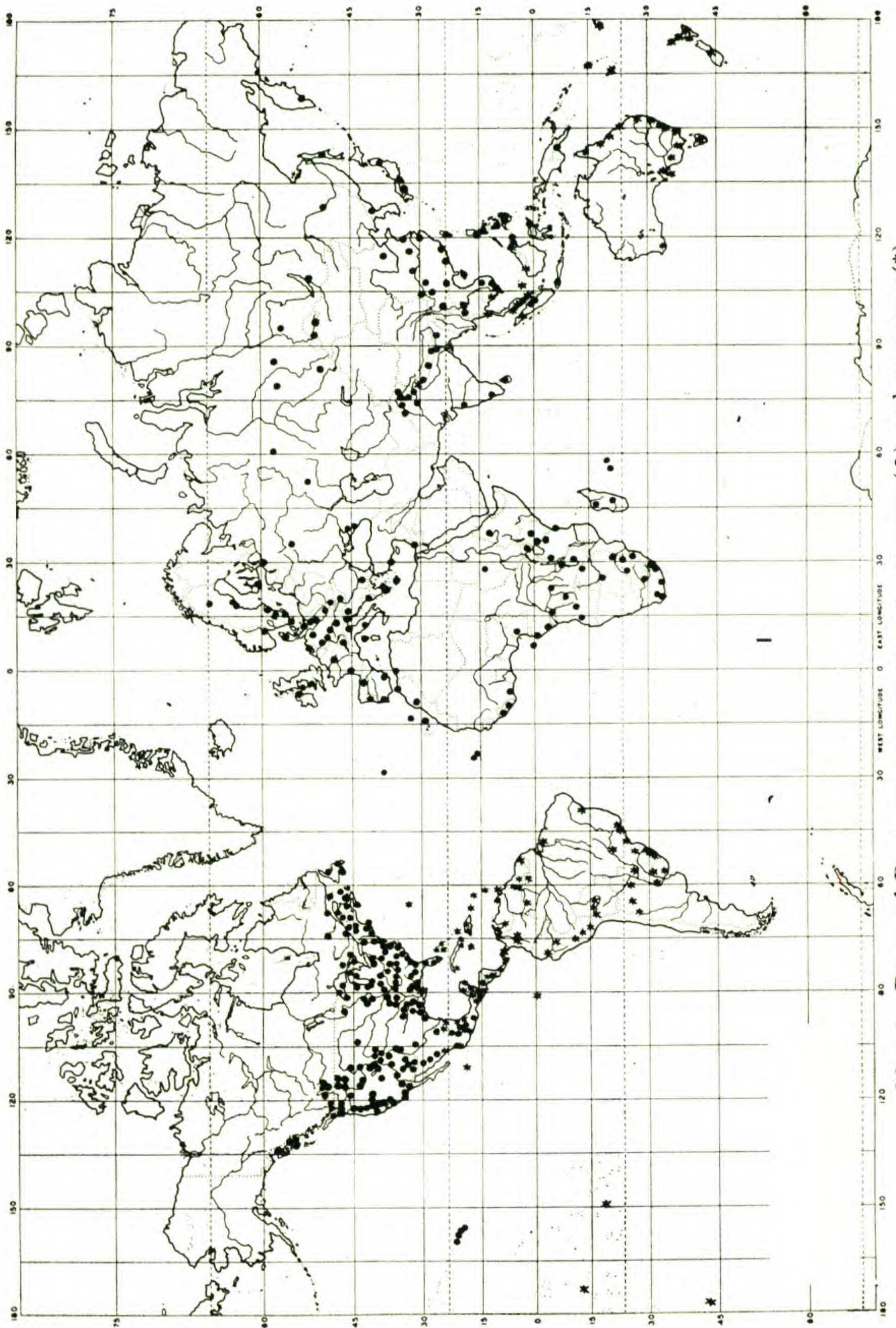
<sup>11</sup> The inner indusium is quite variable in its structure. In some specimens it is a continuous membrane, as figured by Luerss. in Rabenh. Krypt. Fl. Ed. 2, **3**: 101, fig. 81 and Bower (after Luerss.), The Ferns, **3**: 43, in others it is an irregularly broken membrane and in some it consists only of a few hairs.

<sup>12</sup> The user can expect that a considerable number of intermediate and non-typical specimens, especially shade-forms, will not run down satisfactorily.



- c. Pinnae and pinnules long-acuminate; ultimate segments falcate or subfalcate; fertile indusium 0.3 mm. or less wide, the sterile 0.2 mm. or less wide (India to Java, New Guinea and Formosa)...2. var. *Wightianum*, p. 22
- c. Pinnae and pinnules short-acuminate to obtuse; ultimate segments straight; fertile indusium 0.3 mm. or more wide, the sterile 0.2 mm. or more wide. d.
- d. Upper surface of the ultimate segments glabrous or subglabrous, or if pubescent, the margin glabrous. e.
- e. Rachis more or less pubescent; blade lanuginose beneath (Europe, Africa and adjacent islands).  
1. var. *typicum*, p. 15
- e. Rachis glabrous; blade subappressed-lanuginose beneath (Hawaiian Islands) .... 5. var. *decompositum*, p. 40
- d. Upper surface of the ultimate segments pubescent, at least near the margin, and the margin pubescent. f.
- f. Sterile indusium 0.4 mm. or more wide; the fertile portion of the indusium no broader than the sterile on the same segment (Mexico, Guatemala and Honduras) ..... 4. var. *Feei*, p. 37
- f. Sterile indusium 0.25 mm. or less wide; the fertile portion of the indusium broader than the sterile on the same segment (western North America and northern Mexico)...3. var. *pubescens*, p. 26
- b. Fertile and sterile indusium glabrous; ultimate segments glabrous beneath between the margin and the midnerve, or slightly pubescent on part of the segment; pinnules at an oblique angle to the costae. g.
- g. Blade usually quadripinnate, ovate; most of the ultimate segments narrowed at the base, the midnerve beneath glabrous or subglabrous (Africa) ..... 8. var. *africanum*, p. 51
- g. Blade usually bipinnate-pinnatifid or tripinnate, rarely tripinnate-pinnatifid, broadly triangular; the ultimate segments adnate or more often broadest at the base, the midnerve beneath moderately pubescent, sometimes glabrous. h.
- h. Margin of the ultimate segments moderately pubescent; longest entire segment or entire part of a segment about four times as long as broad; the terminal segments mostly 5–8 mm. wide (North America, northern Europe and eastern Asia).  
6. var. *latiusculum*, p. 41
- h. Margin of the ultimate segments glabrous or subglabrous; longest entire segment or part of a segment about nine times as long as broad; the terminal segments mostly 2–4.5 mm. wide (southern and eastern United States)...7. var. *pseudocaudatum*, p. 48
- a. Some of the ultimate segments decurrent only, or more strongly decurrent than surcurrent, usually having a farinaceous appearance beneath; pubescence of the lower surface straight, appressed or arachnoid, rarely sublanuginose or absent (ssp. *caudatum*). i.





Map 1. Range of PTERIDIUM AQUILINUM, ssp. TYPICUM(●) and CAUDATUM(\*).



- i.* Ultimate segments having a farinaceous appearance beneath, except in some glabrous forms; pubescence straight, appressed or arachnoid beneath. *j.*
- j.* No free lobes present on the rachis, costae and costules; the midnerve on the lower surface of the ultimate segments usually glabrous; fertile portion of the indusium broader than the sterile on the same segment; cells of the sterile indusium in rather definite rows, large, averaging 31 per mm. on the margin, the indusium not more than 5 cells wide (southernmost United States, West Indies, Mexico, Central America and northern South America) ..... 9. var. *caudatum*, p. 54
- j.* Free lobes present on the rachis, costae and costules; the midnerve on the lower surface of the ultimate segments usually dark-pubescent; fertile portion of the indusium usually not broader than the sterile on the same segment; cells of the sterile indusium irregularly arranged, small, averaging 48 per mm. on the margin, the indusium at least 6, usually 8 cells wide. *k.*
- k.* Undersurface of the segments with membranous wings on the veins and midnerve, arachnoid-pubescent; margin of the segments often pubescent (West Indies, Mexico, Central America and South America) ..... 10. var. *arachnoideum*, p. 57
- k.* Undersurface of the segments without membranous wings on the veins and midnerve, appressed-pubescent with straight hairs; margin of the segments glabrous (Australia, New Zealand and Polynesia).  
11. var. *esculentum*, p. 61
- i.* Ultimate segments not having a farinaceous appearance beneath, sublanuginose-pubescent beneath (India to Sumatra, Philippine Islands and northeastern Australia) ..... 12. var. *yarrabense*, p. 63

#### PTERIDIUM AQUILINUM ssp. **typicum**

Growing tip of the rhizome usually with a tuft of dark hairs, sometimes naked; rachis glabrous to densely pubescent; pinnules at right angles or at an oblique angle to the costae; *ultimate segments* broadly ovate to oblong, sometimes linear, *adnate or surcurrent, or equally surcurrent and decurrent, or narrowed at the base*, the upper surface glabrous to quite pubescent, the *lower surface lanuginose-pubescent or glabrous, not having a farinaceous appearance*; cells of the sterile indusium of medium size, usually irregularly arranged. MAP 1 (dots).

#### 1. PTERIDIUM AQUILINUM var. **typicum**,<sup>13</sup> PLATE 650, FIG. 2,

<sup>13</sup> Only the more important, the more obscure and scattered, and the more widely used subspecific names and combinations are cited. About one hundred new subspecific names and combinations in Lowe, *Our Native Ferns*, Druery, *British Ferns and their Varieties*, Junge, *Die Pteridophyten Schleswig-Holsteins*, Kaulfuss, *Die Pteridophyten* and Gandoger, *Flora Europae terrarumque adjacentium* are omitted from the synonymy. Some names from other well known but less detailed works are also omitted. All of these names apparently represent trivial variations. Gandoger's treatment (*op. cit.* 27: 180 (1891)), the opening portion of which is here quoted, amounts almost to a naming of individuals:



PLATE 651, FIG. 4, MAP 4. Illustrations: Fl. Dan. **13**: t. 2303 (1840); Waldner, Deutschl. Farne t. 17 (1883); Schk. Krypt. Gew. t. 95 (1809); Lowe, Native Ferns **2**: 407, t. 61 (1867); Marloth, Fl. S. Africa **4**: pl. 37 (1915), *habitat*.

*Pteris aquilina* L. Sp. Pl. 1075 (1753). *Cincinnatiensis aquilina* (L.) Gled. Verm. Abh. **1**: 24 (1765), reference taken from Woy-nar, Hedwigia **56**: 381 (1915). *Pteris nudicaulis* Güld. Reisen Russ. **1**: 421 (1787), according to C. Chr. Ind. Fil. 603 (1906). *Pteris borealis* Salisb. Prod. 402 (1796). *Asplenium aquilinum* (L.) Bernh. Schrader's Journ. **1799**<sup>1</sup>: 310 (1799). *Pteris capensis* Thunb. Prod. **2**: 172 (1800); fragment of type at NY. *Pteris lanuginosa* Bory ex Willd. Sp. Pl. **5**: 403 (1810); fragment of type at NY. *Pteris aquilina* L. var. *ciliata* Opiz, Kratos **2**<sup>1</sup>: 19 (1820).<sup>14</sup> *Pteris aquilina* L. var. *sinuata* Opiz, Kratos **2**<sup>1</sup>: 19 (1820). *Pteris foemina* Gray, Nat. Arr. Brit. Pl. **2**: 16 (1821). *Allosorus aquilinus* (L.) Pr. Tent. Pterid. 153 (1836). *Allosorus lanuginosus* (Bory ex Willd.) Pr. Tent. Pterid. 154 (1836). *Allosorus hottentottus* Pr. Tent. Pterid. 154 (1836). *Allosorus acutifolius* Pr. Tent. Pterid. 154 (1836), nomen nudum. *Allosorus villosus* Pr. Tent. Pterid. 154 (1836), nomen nudum. *Allosorus tauricus* Pr. Tent. Pterid. 154 (1836), nomen nudum. *Pteris brevipes* Tausch, Flora **19**<sup>2</sup>: 427 (1836). *Pteris lanuginosa* Bory ex Willd. var. *capensis* (Thunb.) Ag. Rec. Pterid. 51 (1839). *Pteris plebia* R. Br. ex Ag. Rec. Pterid. 52 (1839), in synonymy. *Pteris coriifolia* Kze. Linnaea **18**<sup>2</sup>: 120 (1844). *Pteris aquilina* L. var. *vera* Moore, Handb. Brit. Ferns, Ed. 1, 134 (1848), reference taken from Moore, Pop. Hist. Brit. Ferns, 167 (1851). *Pteris aquilina* L. var. *integerrima* Moore, Handb. Brit. Ferns, Ed. 1, 134 (1848), reference taken from Moore, Pop. Hist. Brit.

"20. *Pteris* L.

1. *PTERIS AQUILINA* L.

Hab. Europa tota.

1	{	Lobi sup. integri 4 mm. longi	2
		Lobi sup. integri 5 mm. longi	5
		Lobi sup. integri 6 mm. longi	8
		Lobi sup. integri 7 mm. longi	17
		Lobi sup. integri 8 mm. longi	28
		Lobi sup. integri 9 mm. longi	34
		Lobi sup. integri 10 mm. longi	40
		Lobi sup. integri 11 mm. longi	45
		Lobi sup. integri 12 mm. longi	47
2	{	Pinnae remoti	3
		Pinnae contiguae	4
3	{	Lobi obtusi- <i>Pedem., Vallées Vaudoises</i> (Rostan)	<i>P. polystichoides</i> Gdgr.
		Lobi acuti- <i>Basses-Pyren., m. Lestibette</i> (Gdgr.)	<i>P. oreodoxa</i> Gdgr."

<sup>14</sup> I am indebted to Prof. Dr. Adolf Pascher for the references to Kratos, a periodical apparently not in the United States.



Ferns, 167 (1851). *Pteris aquilina* L. var. *pubescens* Spreng. ex Liebm. Vid. Selsk. Skr. s. 5, **1**: 225 (1849), as to basonym, *Pteris lanuginosa* Bory ex Willd., not as to plant. *Pteris aquilina* L. var. *multifida* Moore, Handb. Brit. Ferns, Ed. 3, 226 (1857). *Pteris aquilina* L. var. *crispa* Moore, Handb. Brit. Ferns, Ed. 3, 226 (1857). *Pteris aquilina* L. var. *pubescens* Afz. fil. ex Hook. Sp. Fil. **2**: 198 (1858), in synonymy. *Pteris aquilina* L. var. *lanuginosa* (Bory ex Willd.) Hook. Sp. Fil. **2**: 196 (1858). *Allosorus capensis* (Thunb.) [incorrectly attributed to Presl by] Pappe & Raws. Syn. Fil. 32 (1858). *Allosorus coriifolius* (Kze.) Pappe & Raws. Syn. Fil. 31 (1858). *Paesia coriifolia* (Kze.) Moore, Gard. Chron. **1858**: 878 (1858). *Aquilina vulgaris* Pr. ex Milde, Fil. Eur. 45 (1867), in synonymy. *Pteris Heredia* Clem. ex Colm. Enum. crypt. Esp. y Port. **1**: 16 (1867), reference taken from C. Chr. Ind. Fil. 599 (1905) and Colmeiro, Enum. Plantas Hisp.-Lusit. **5**: 437 (1889). *Paesia aquilina* (L.) Keys. Pol. Cyath. Hb. Bung. 22 (1873). *Ornithopteris aquilina* (L.) J. Sm. Hist. Fil. 298 (1875). *Cincinnati lanuginosa* (Bory ex Willd.) Trevis. Atti Soc. Ital. sc. nat. **17**: 239 (1875). *Pteris gracilis* Paterson in Henedy, Clydesd. Fl. Mem. Ed. 255 (1878). *Pteridium aquilinum* (L.) Kuhn var. *lanuginosum* (Bory ex Willd.) Kuhn in v. d. Decken, Reisen in Ost-Afrika **3**<sup>3</sup>: 11 (1879). *Pteris aquilina* L. var. *abbreviata* Gillot, Bull. Soc. Bot. France **29**: June, xxii (1882). *Pteris abbreviata* (Gillot) Gerard, Bull. Soc. Bot. France **29**: June, xxii (1882). *Pteris aquilina* L. var. *transsilvanica* Schur, Enum. Pl. Transs. 841 (1885), nomen nudum. *Pteridium aquilinum* (L.) Kuhn var. *brevipes* (Tausch) Luerss. in Rabenh. Krypt. Fl. Ed. 2, **3**: 107 (1889). *Pteridium aquilinum* (L.) Kuhn var. *umbrosum* Luerss. in Rabenh. Krypt. Fl. Ed. 2, **3**: 107 (1889). *Pteris aquilina* L. var. *normalis* O. Ktze. Rev. Gen. **2**: 820 (1891). *Pteris aquilina* L. f. *lanuginosa* (Bory ex Willd.) O. Ktze. Rev. Gen. **2**: 820 (1891). *Pteridium aquilinum* (L.) Kuhn var. *osmundaceum* Christ, Beiträge Krypt. Schweiz **1**<sup>2</sup>: 54 (1900). *Pteridium aquilinum* (L.) Kuhn var. *capense* (Thunb.) Christ, Beiträge Krypt. Schweiz **1**<sup>2</sup>: 55 (1900). *Pteridium capense* (Thunb.) Krasser in Zahlbruckner, Ann. Nat. Hofm. Wien, **15**<sup>1</sup>: 4 (1900). *Pteridium lanuginosum* (Bory ex Willd.) Clute, Fern Bull. **8**: 38 (1900), as to name-bringing synonym, not as to plant. *Pteridium cheginense* Barnola, Bol. Soc. Aragonesa Cienc. Nat. **11**: 35 (1912). *Pteridium aquilinum* (L.) Kuhn var. *crispulatum* Barnola, Bol. Soc. Aragonesa Cienc. Nat. **11**: 35 (1912). *Pteridium aquilinum* (L.) Kuhn ssp. *capense* (Thunb.) Bonap. Notes Ptérid. **2**: 66 (1915). *Filix aquilina* (L.) Woynar, Hedwigia **56**: 383 (1915). *Filix-foemina aquilina* (L.) Farwell, Am. Mid. Nat. **12**: 290 (1931).

In 1848 Moore published *Pteris aquilina* L. var. *vera* but he



did not base it on *Pteris aquilina* L. He described it as having the secondary pinnules pinnatifid, while the Fuchs plate, the type of *Pteris aquilina*, has the secondary pinnules entire (in fact the pinnules are only pinnatifid). In contrast to his var. *vera* he had var. *integerrima*, secondary pinnules entire. He apparently thought of var. *vera* as the more common and hence more "typical" phase and his description of it excludes the type of *Pteris aquilina*.

Kuntze published a *Pteris aquilina* L. var. *normalis* in 1891 but did not actually base it on *Pteris aquilina* L. and circumscribed it much more broadly than the typical variety in the present treatment. "U. St.: Oil City" includes var. *latiusculum* and "Hongkong" includes either var. *latiusculum* or var. *Wightianum*.

Because of the above objections to taking up either var. *vera* Moore or var. *normalis* O. Ktze., I am designating the typical variety as var. *typicum*, definitely based on the type of *Pteris aquilina* L.

*Growing tip of the rhizome with a tuft of dark hairs; frond 0.4–4 m., usually about 1–1.5 m. high, the taller fronds scandent, vernation gleichenioid; stipe longer or shorter than the blade; blade 2–20 dm., usually about 6–10 dm. long, usually ovate-triangular, less often ovate or broadly triangular, not ternate, bipinnate-pinnatifid or tripinnate, less often tripinnate-pinnatifid, rarely quadripinnate-pinnatifid; rachis usually moderately pubescent, less often densely pubescent or subglabrous; pinnae and pinnules short-acuminate to obtuse; pinnules usually nearly at right angles to the costa, sometimes at an oblique angle; costules slightly to densely pubescent beneath and less so above; penultimate segments usually pinnatifid, less often pinnate or pinnate-pinnatifid; longest entire segment or part of a segment from three to six, usually about four, times as long as broad; ultimate segments usually straight, rarely subfalcate, adnate or broadest at the base, the upper surface usually glabrous or slightly pubescent, rarely moderately pubescent, the margin glabrous or subglabrous, rarely moderately pubescent, the lower surface usually densely pubescent, less often slightly pubescent, rarely glabrous or pubescent only on the midnerve; fertile and sterile indusium ciliate and sometimes also pubescent on the outer surface, the fertile usually 0.3 mm. or more wide, the sterile usually 0.2 mm. or more wide, the fertile portion broader than the sterile on the same segment, or no broader.*



TYPE: Figure of *Filix femina* Fuchs, Hist. 596, misprinted 569 (1542). Linnaeus did not have a specimen of *Pteris aquilina* in his herbarium in 1753 and the only illustration cited by him is taken as the type.

TYPE LOCALITY: Europe.

I have not been able to separate the African Bracken from the European. Extreme specimens from Africa differ from the typical European plant (*Tidestrom* 13295, France) in having a densely pubescent, flexuous rachis and the fertile indusium no broader than the sterile on the same segment. However, these characters are not always correlated and they show no definite geographic segregation. Specimens with the rachis densely pubescent and flexuous have been seen from Mauritius, "Ex. Herb. Wm. Boott" (G) and Madagascar, Herb. Field Mus. no. 595745. Specimens from British East Africa, *E. Heller*; Natal, *Abraham* 28; Cape of Good Hope, U. S. Nat. Herb. no. 22419; St. Thomas, *Moller* 33 and Sierre Leone, *Johnston* 7 have the rachis densely pubescent but straight. Distributed over essentially the same area are specimens that have a straight glabrous rachis: Egyptian Sudan, *Lynes* 186; British East Africa, *Mearns* 1229; Kilimanjaro, *Abbott*; Madagascar, *Webb* (?) 113 (G); Bourbon, *Halsey* (U. S. Nat. Herb. no. 1285441); and Cape of Good Hope, *Sim* 1579. Most of the European and about half of the African specimens have the fertile indusium broader than the sterile on the same segment. Specimens from the Azores, Madeira and Canary Islands and from northernmost Africa are distinctly of the European type.

Shade forms often approach var. *latiusculum* in some characters: they may be almost completely glabrous (*Ziesché*, Herb. Field Mus. no. 764960; Prov. Westfalen (G); *Kaulfup*, Bavaria (US)) or only slightly pubescent with the sterile indusium considerably less ciliate than normally (*Ziesché*, Reisingebirge, Silesia; *Richter*, Hungary).

Intermediates between var. *typicum* and var. *latiusculum* are only slightly pubescent beneath except on the midnerve and have the fertile and sterile indusium only slightly ciliate. Such are Danzig, July 24, 1876, *Baenitz* (F); Pl. Scand. ex insula Gotlandia, June 16, 1894, *Johansson* (US); Plantae Goreanae, *Taquet* 2317 (US); and Hungary, Aug., 1893, *Marton* (F).



Some specimens, here referred to var. *latiusculum*, approach var. *typicum* in one or more characters. The sterile indusium may be slightly ciliate and the blade pubescent beneath between the margin and the midnerve and the blade ovate: Pl. Sibiricae Exsicc. 1288, Tomsk; *Honig*, Bavaria; near Berlin, 1844. In *A. O. Olson*, Vestrogothia, Sweden, Aug. 17, 1915 (F) the indusium is slightly pubescent.

Several minor variations have been named, some of which may be worthy of recognition as forms, but I do not feel justified in recognizing them in view of the limited amount of material I have seen and the lack of field experience. Some of the variations that have been described certainly do not deserve recognition. *Pteris aquilina* var. *abbreviata* Gillot, for instance, is a much stunted plant found growing under extremely unfavorable conditions, on rocks and bathed in a sulphurous vapor at 20° C. *Pteridium cheginense* Barnola is a young plant with abnormal leaf-cutting and *Pteris gracilis* Patterson is also a young plant.

Var. *typicum* differs from var. *latiusculum* in its gleichenioid rather than equal vernation, in having the undersurface of the segments densely pubescent rather than pubescent only on the midnerve, in the glabrous rather than pubescent margin of the segments and the ciliate rather than glabrous fertile and sterile indusium. Also the frond is considerably taller on the average and the blade is ovate to ovate-triangular and evenly pinnate rather than broadly triangular with the basal pinnae considerably longer and broader than the second pair. The pinnules are usually at right angles to the costa rather than at an oblique angle and the penultimate segments are usually evenly pinnatifid rather than pinnate or pinnate-pinnatifid.

The critical differences between var. *typicum* and vars. *Wightianum*, *pubescens* and *Feei*, with which it is also closely related are discussed under those varieties. It is perhaps most closely related to var. *pubescens* of western North America—probably representing another example of the well-known relationship of the floras of western North America and Europe.

Var. *typicum* grows in open woods, in clearings, at the edge of woodlands, in thickets, in pastures, in abandoned fields, in grassy places, on open hillsides, in forests and in recently burned-



over areas. It is most common in dry places and in acid soils. It grows from sea-level to about 1800 m. in the Alps and to 3000 m. in the mountainous regions of Africa.

It ranges throughout Europe and all but the drier regions of Africa, and adjacent islands.

EURASIA.—SWEDEN: Helsingborg, July, 1862, *Suetberg* (Herb. Field. Mus. no. 335698). IRELAND: Holywood, Oct. 20, 1884, (G). GREAT BRITAIN: Snowdon (Wales), July 19, 1905, *Pease* 8031 (G); Isle of Man, Sept., 1895, *Underwood* (NY). NETHERLANDS: Haaksbergen, July 20, 1918, *Boetje van Ruyven* (Herb. Field Mus. no. 840219). GERMANY: Heidelberg, Sept. 19 (Herb. Field Mus. no. 756408); Münsterland, Prov. Westfalen, Aug. 19, 1905 (G); Zabtengebirge, Mittelberg, Silesia, Aug. 29, 1906, *Ziesché* (Herb. Field Mus. no. 764960); Reisingebirge, Silesia, July 20, 1903, *Ziesché* (G); Spandau, Brandenburg, Sept., 1880, *Ruhmer* (F. Schultz herb. norm. no. 975) (G, NY); Nürnberg, Bavaria, Aug. 26, 1902, *Kaulfup* (US). CZECHOSLOVAKIA: Aug., 1911, *Petrak* (Fl. Bohemiae et Moraviae exsicc. no. 603) (G). HUNGARY: Klausenberg, Aug. 16, 1901, *Richter* (G); Piliscaba, Sept., 1916, *Filarszky & Kümmerle* (Fl. Hung. exsicc. no. 431) (F, G, US); Orawicza, *Wierzbicki* (Herb. Field Mus. no. 47805). SWITZERLAND: *Wilazek* (G). FRANCE: Bures, Sept. 26, 1909, *Jeanpert* (Herb. Field Mus. no. 815531); Perignac, Charente, Sept. 4–11, 1893, *Guillon* (Mangier, Fl. selecta exsicc. no. 3395) (F); July 11, 1934, *Tidestrom* 13295 (F, G, US); May 9, 1935, *Tidestrom* 13509 (NY); Vicinity of Paris, June 28, 1911, *Jeanpert* (Herb. Field Mus. no. 815529). SPAIN: San Sebastian, *Barbour* (NY). PORTUGAL: Porto, 1891, *Buchtien* (U. S. Nat. Herb. no. 1095027). CORSICA: July 20, 1933, *Aellen* 1306 (F, US); June 17, 1933, *Aellen* 1316 (F, US). ITALY: Venetia, Nov. 10, 1907, *Fiori, Béguinot & Pampanini* (Fl. It. exsicc. no. 705) (G); Capri, Aug. 29, 1909, *Ware* (G, US); Near Rome, *Pisotta* 34 (F). GREECE: Olympia, April 27, 1906, *Pease* 9081 (G). TURKEY: Taurus Mts., Aug. 12, 1907, *Wankow* (NY); "Plantae Tauricae," *Wankow* (US). UNION OF SOVIET SOCIALIST REPUBLICS: Dist. of Chernomose (Black Sea), *Kousenetzoff* (G); Caucasus, Kuban Prov., May 9, 1907, *Busch & Klopotow* (G); Western Grusia, Caucasus, *Meffert* 20 and 910 (G).

AFRICA.—ALGERIA: Oran, May 9, 1935, *Faure* (U. S. Nat. Herb. no. 1674024, NY). MOROCCO: 1889, *T. Williams* 118 (US). AZORES: 1890, *Chute* (G); July 18, 1894, *Brown* 334 (G). MADEIRA: 1853–56, *Wright* (G); 1838–42 (U. S. South Pacific Exploring Expedition) (G). CANARY ISLANDS: Grand Canary, Feb., 1897, *Cooke* 107 (F, G, NY, US). SIERRA LEONE: Oct., 1875 (Herb. Field Mus. no. 69396); Freetown, April 8, 1882, *H. H.*



*Johnston* 7 (G). LIBERIA: Grand Bassa, *Dinklage* 1628 (G); along Dukwai River near Firestone Plantations, 1928, *G. P. Cooper* 21 (F, NY, US). CAMEROON: Jan., 1919, *Gocker* 133 (G). ST. THOMAS (Is.): 1885, *Moller* 33 (US). FRENCH EQUATORIAL AFRICA: Fernand Vaz, French Congo, 1917, *Aschemeier* 19 (US). UNION OF SOUTH AFRICA. CAPE OF GOOD HOPE: Vicinity of Cape Town (U. S. South Pacific Exploring Expedition) (U. S. Nat. Herb. no. 22419); King Williamstown, 1892, *Sim* 1579 (G). NATAL: Mapumulo, 1867-69, *Abraham* 28 (G, US); *Buchanan* 534d (US). TRANSVAAL: Bokfontein, Aug. 3, 1934, *Mogg* 4755 (US); Rustenburg, (District of) Rustenburg, Sept., 1910, *Collins* (Herb. Field Mus. no. 653635).—MADAGASCAR: 1897 (Herb. Field Mus. nos. 595715, 595725, 595745, U. S. Nat. Herb. nos. 1431040, 1431121); *Webb*(?) 113 (G). BOURBON: (Herb. Field Mus. no. 830986); *Halsey* (U. S. Nat. Herb. no. 1285441). MAURITIUS: 1867, *Pike* (U. S. Nat. Herb. no. 593158); (U. S. Nat. Herb. no. 516236). TANGANYIKA (GERMAN EAST AFRICA): Kilimanjaro, 1889-90, *Abbott* (U. S. Nat. Herb. nos. 22433, 22472); Ulugurus, Bunduki, Aug. 2, 1935, *Bruce* 96 (US). ZANZIBAR: Oct., 1873, *Hildebrandt* (NY). UGANDA: Mt. Debasién, Jan., 1936, *Eggeling* 2703 (G); Vicinity of Kigomma, Dec. 30, 1909, *Mearns* 2617 (US); Kikayo, *Dümmer* 551 (US). KENYA (BRITISH EAST AFRICA): Mau Range, July 27, 1923, *A. G. Curtis* 848 (G); Lake Naivasha, July 17 to Aug. 15, 1909, *Mearns* 929 (US); Wambugu, Sept. 13, 1909, *Mearns* 1229 (G, US); Mbololo, Nov. 7-11, 1911-12, *E. Heller* (U. S. Nat. Herb. no. 634399). EGYPTIAN SUDAN: Jebel Marra, Dafur, Dec., 1921, *Lynes* 186 (US). ABYSSINIA: 1842, *Schimper* 856 (US).

2. *PTERIDIUM AQUILINUM* var. **Wightianum** (Ag.), n. comb. PLATE 650, FIG. 1, PLATE 651, FIG. 3, MAP 2. Illustration: *Bedd. Ferns S. India*, t. 42 (1863).

*Pteris revoluta* Bl. Enum. Pl. Jav. 214 (1828). *Pteris excelsa* Bl. Enum. Pl. Jav. 213 (1828). *Pteris lanigera* Bl. Enum. Pl. Jav. 214 (1828). *Pteris densa* Wall. List no. 99 (1829), nomen nudum, isotype at US. *Pteris firma* Wall. List no. 100 (1829), nomen nudum. *Pteris terminalis* Wall. List no. 101 (1829), nomen nudum. *Pteris recurvata* Wall. List no. 113 (1829), nomen nudum; ex Ag. Rec. Pterid. 50 (1839), isotype at US. *Pteris Wightiana* Wall. List no. 2178 (1829), nomen nudum. *Allosorus recurvatus* (Wall.) Pr. Tent. Pterid. 154 (1836), nomen nudum. *Pteris recurvata* Wall. ex Ag. var. *Wightiana* Ag. Rec. Pterid. 50 (1839), as *Wigtiana*, epithet taken from *Pteris Wightiana* Wall. *Pteris villosa* Fée, Gen. Fil. Mém. Fam. Foug. 5: 128 (1850-1852). *Cincinalis villosa* (Fée) Trevis. Atti Soc. Ital. sc. nat. 17: 239 (1875). *Pteridium aquilinum* (L.) Kuhn



var. *osmundoides* Christ ex Lévillé, Bull. Acad. Geogr. Bot. **20**: no. 243, 9 (1910), nomen nudum. *Pteridium capense* (Thunb.) Krasser var. *densa* Nakai, Bot. Mag. Tokyo **39**: 109 (1925), epithet taken from *Pteris densa* Wall. *Pteridium revolutum* (Bl.) Nakai, Bot. Mag. Tokyo **39**: 109 (1925).

Growing tip of the rhizome with a tuft of dark hairs; *frond* 0.6–4 m. high, the taller fronds scandent, *vernation* *gleichenioid*; stipe usually shorter than the blade; *blade* 0.3–3 m., usually about 1.1–5 m. long, *ovate-triangular*, or less often pentagonal, not ternate, usually tripinnate-pinnatifid, less often bipinnate-pinnatifid or tripinnate; *rachis* usually *densely or very densely pubescent*, rarely becoming subglabrous; *pinnae and pinnules* usually *long-acuminate*, infrequently short-acuminate; *pinnules* usually *nearly at right angles* to the costa, less often at a somewhat oblique angle; costules slightly to densely pubescent beneath and less so above; penultimate segments usually pinnatifid, less often pinnate or pinnate-pinnatifid; longest entire segment or part of a segment from three to seven, usually about four, times as long as broad; *ultimate segments* usually *falcate* or subfalcate, adnate or broadest at the base, the upper surface usually glabrous or slightly pubescent, the margin glabrous to moderately pubescent, the *lower surface* usually *densely pubescent*, less often slightly pubescent, rarely glabrous or pubescent only along the midnerve; *fertile and sterile indusium ciliate* and sometimes also *pubescent* on the outer surface, rarely glabrous, the *fertile* usually 0.3 mm. or less wide, the *sterile* usually 0.2 mm. or less wide, the *fertile portion no broader than the sterile* on the same segment.

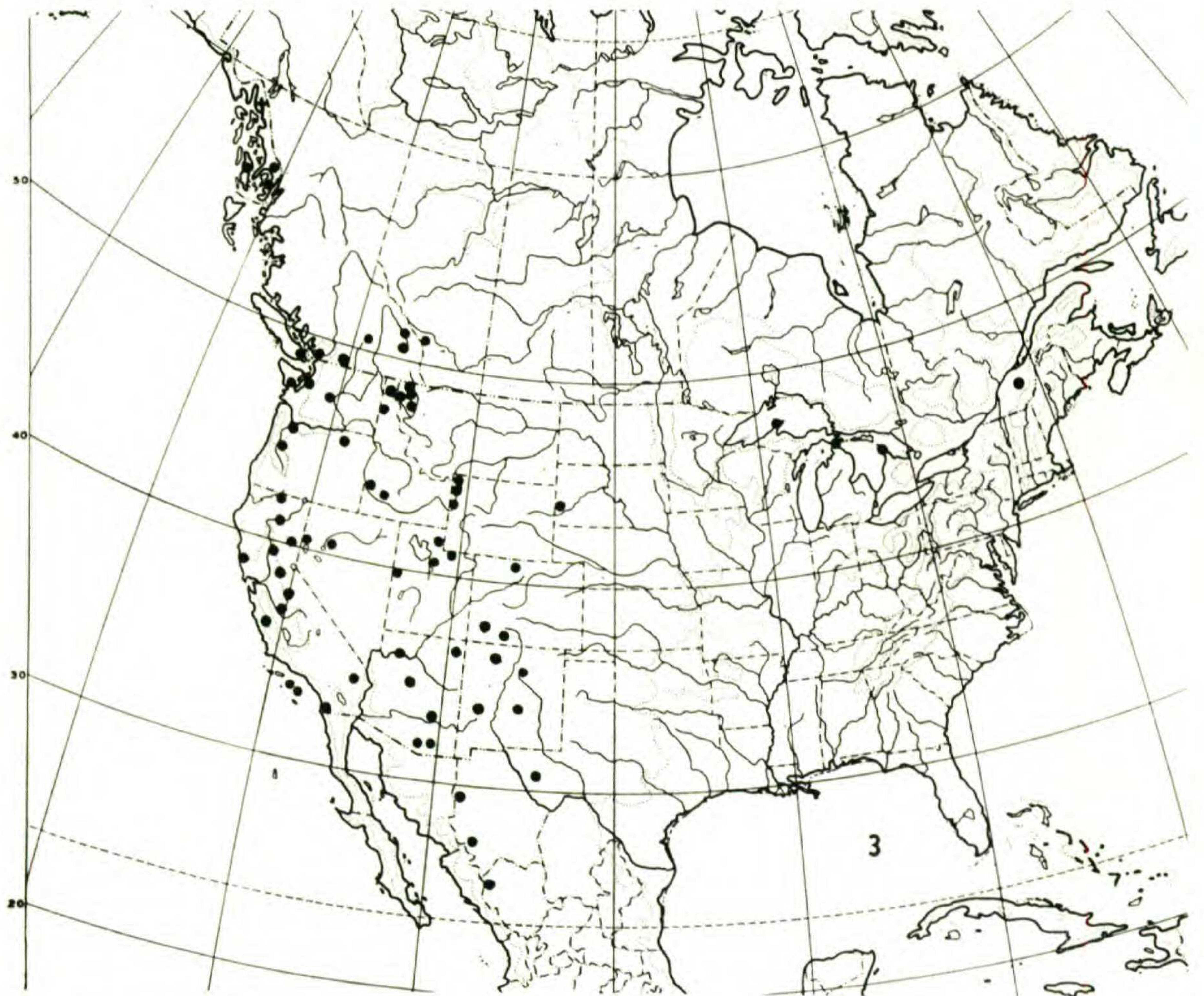
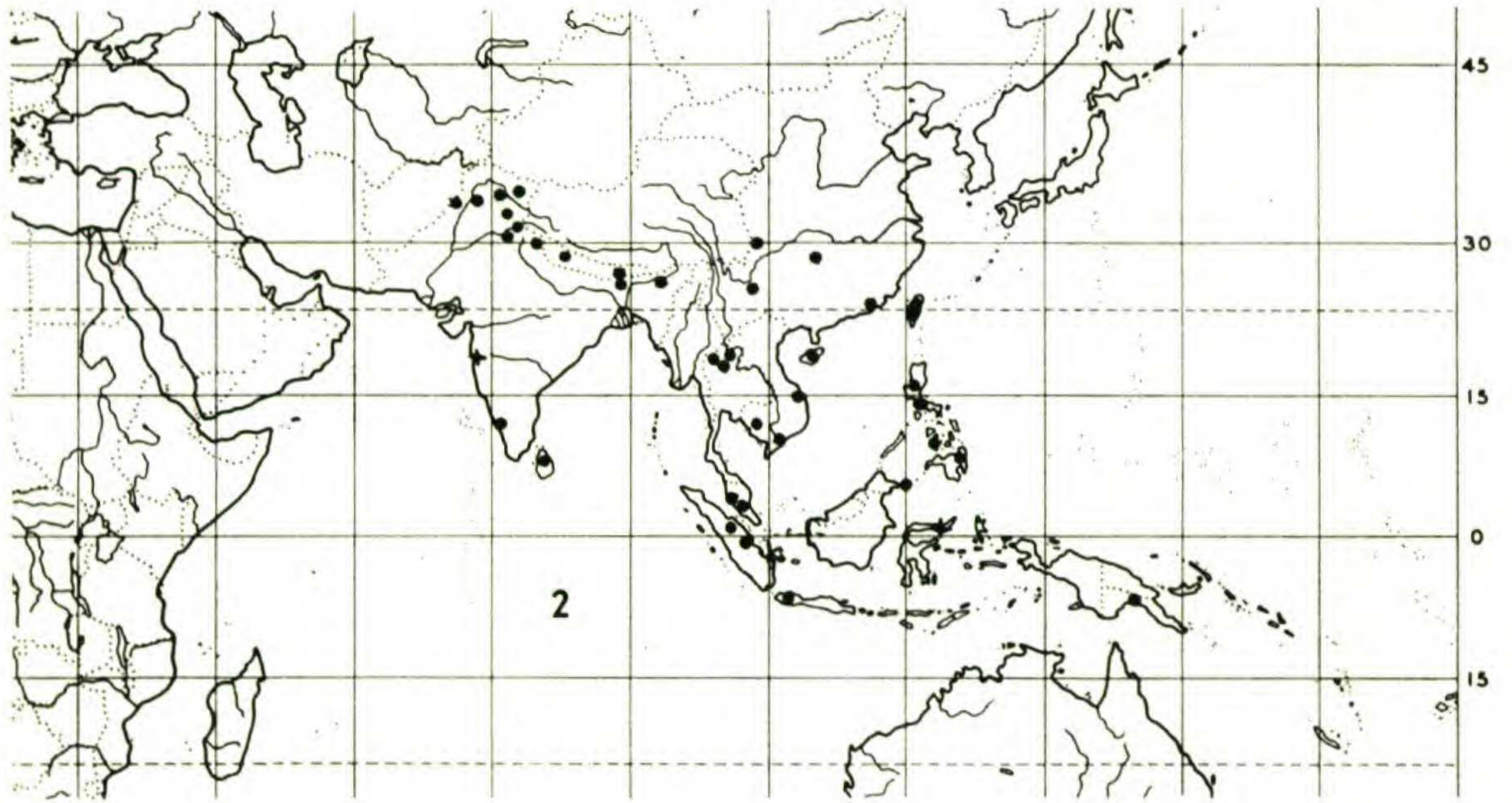
TYPE: Wallich 2178, at Kew (not seen).

TYPE LOCALITY: Dindygul, India.

Specimens from the Himalayas (*R. R. & I. D. Stewart* 4761, 4048; *Stewart* 6492) are almost completely glabrous and *Stewart* 6492 has the ultimate segments narrowed at the base. However, they have the long-acuminate pinnae and pinnules of typical var. *Wightianum* and probably represent only a local variation. Other material from the same region is entirely typical. Some specimens approach var. *typicum* and var. *latiusculum* in having a nearly glabrous rachis (*Henry*, China; *Fang* 3281, China) or acuminate to obtuse pinnules (*Bartsch* 153, Philippine Is.; *Sallet*, Indo-China).

Var. *Wightianum* can be separated from var. *typicum*, with which it is apparently closely related, by its much more densely pubescent rachis, its long-acuminate rather than subacute or





Ranges of *PTERIDIUM AQUILINUM*, var. *WIGHTIANUM* (map 2); var. *PUBESCENS* (map 3).



obtuse pinnae and pinnules, its falcate rather than straight ultimate segments and the narrower fertile and sterile indusium. The critical differences between var. *Wightianum* and var. *latiusculum*, with which it intergrades, are discussed under that variety.

Var. *Wightianum* grows on dry hillsides, in jungle clearings, on waste slopes, on craters and in grassland, usually in sterile, often dry, soil. It occurs from 700 m. to 3300 m. in India and up to 2500 m. in China and 2800 m. in Papua.

It ranges from northwesternmost India east to Formosa, south to Ceylon, Java and British New Guinea.

INDIA: N. W. India, 1871, *J. L. Stewart* 3626 (NY); Nazara, N. W. Himalayas, May 16, 1896 (US Nat. Herb. no. 1274966); Simla Region, Simla, Sept. 18, 1883, *Blanford* (NY); Sonamarg, Kashmir, July 28, 1921, *R. R. Stewart* 6492 (NY, US); Tragbal, Kashmir, July 31, 1919, *R. R. & I. D. Stewart* 4761 (NY, US); Murree Hills, Changla Gali, Punjab, Sept. 12, 1918, *R. R. & I. D. Stewart* 4048 (NY, US); Halann, Kulu, Punjab, May 21, 1931, *Koelz* 1980 (US); Kumaon, *Strachey & Winterbottom* 8 (G); Dalhousie, Punjab, June 9, 1917, *R. R. & I. D. Stewart* 2182 (NY, US); Nepal, 1820, *Wallich* 113 (US), isotype of *Pteris recurvata* Wall.; Khasi Hills, Shillong, Assam, Sept., 1888, *Mann* (NY, US); Sikkim, *Hooker* (G); Nilghiri, *Thomson* (G); 40 miles north of Darjeeling, Dec., 1884, *native collector* (NY). CEYLON: *Beckett* 182 (G); (U. S. Nat. Herb. no. 816885); (U. S. Nat. Herb. no. 22423); *G. Wall* (NY). SIAM: Doi Sutep, Dec. 15, 1928, *H. M. Smith* 410 (G, US); Doi Chang Mt. near Hue San, Chiangmai Prov., Jan. 10, 1922, *Rock* 1720 (NY, US); Jan Khien, Doi Sootep, Chiangmai, Aug. 14, 1931, *Cunniff* 7 (NY). FRENCH INDO-CHINA: Annam, Massif de Bah-Na, 30 miles southwest of Tourane, Aug., 1920, *Sallet* (G, NY, US); Cochinchina, May, 1870, *Pierre* 5793 (US); Angkor, Cambodia, Jan. 14, 1926, *H. M. Smith* 295 (US). FEDERATED MALAY STATES: Perak, 1887, *Wray* 1486 (US); Penang, 1822, *Wallich* 99 (US), isotype of *Pteris densa* Wall.; Pulan Tulai, Pahang, May 27, 1927, *Henderson* 18525 (US). CHINA. KWANGTUNG: Canton and vicinity, Nov. 11, 1917, *Levine* 1834 (G). HAINAN: Hainan, Dec. 18, 1933, *Wang* 35562 (NY). KWEICHOW: Kyingtenshan, Tsunyi, Jan. 3, 1930, *Tsiang* 5241 (G, NY); Liang Feng Yah, Tsunyi Hsien, July 31, 1931, *Steward, Chiao & Cheo* 53 (F, NY, US). YUNNAN: Between Mohei and Moakai, March 20–April 7, 1922, *Rock* 2906 (G). SZECHUAN: Mt. Omei, Omei Hsien, 1928, *Fang* 3281 (G); Patung District, Feb., 1887, *Henry* (G).—FORMOSA: Arisan, Dec. 4, 1933, *Kanehira* 2995 (NY, US); Shakko,



Dec., 1913, *Faurie* (E. Rosenstock exsicc. no. 51) (G); Mt. Taihei, Taiheisan, Sept. 28, 1926, *Bartlett* 6034 (US).

PHILIPPINE ISLANDS: Dumaguete, Island of Negros, Prov. Negros Oriental, June, 1908, *Elmer* 10349 (G, NY, US); Port of Dos Amigos, Twai Twai Island, Feb. 19, 1908, *Bartsch* 153 (G, NY, US); Twin Peaks, Benguet Road, Luzon, March 2, 1908, *Bartsch* 210 (G, NY, US); Bosoboso, Prov. Rizal, Luzon, June, 1896, *Ramos* (Herb. Phil. Bureau Sci. no. 1054) (US); Bukidnon, Mindanao, July–Aug., 1913, *Escritor* (Herb. Phil. Bureau Sci. no. 21414) (US). BORNEO: *Korthals* (NY). SUMATRA: Aels Kanopan, Loendoet Concession, Koealoe, March 19, 1927, *Bartlett* 6993 (US); Toba, *Ouwchand* 204 (G). JAVA: Tjiboeroem, Preanger Prov., April 12, 1909, *Palmer & Bryant* 171 (US); vicinity of Goenoeng Boender, Batavia Prov., May 16, 1909, *Palmer & Bryant* 529 and 541 (US). PAPUA (BRITISH NEW GUINEA): Murray Pass, Wharton Range, Central Division, June–Sept., 1933, *Brass* 4634 (G, NY).

3. *PTERIDIUM AQUILINUM* var. *PUBESCENS* Underw. Our Nat. Ferns, Ed. 6, 91 (1900). PLATE 650, FIG. 3, PLATE 652, FIG. 5, MAP 3. Illustration: Ashton, Pl. Rocky Mt. Nat. Pk. 22 (1933), *habitat*.

*Pteris aquilina* L. var. *lanuginosa* Bong. Mém. Acad. St. Petersb. s. 6, 2: 176 (1832), isotype at G. *Pteridium lanuginosum* (Bory ex Willd.) Clute, Fern Bull. 8: 38 (1900), as to plant, not *Pteris lanuginosa* Bory ex Willd.; nomen provisorium. *Pteris lanuginosa* sensu Clute, Fern Bull. 8: 37 (1900), not Bory ex Willd. *Pteris aquilina pubescens* (Underw.) Clute, Fern Bull. 15: 124 (1907). *Pteridium latiusculum* (Desv.) Hieron. ex Fries var. *pubescens* (Underw.) [combination incorrectly attributed to Underw. by] Seymour, Host Ind. 25 (1929). *Filix-foemina aquilina* (L.) Farwell var. *lanuginosa* (Bong.) Farwell, Am. Mid. Nat. 12: 290 (1931). *Pteris aquilina* L. var. *pubescens* (Underw.) [combination apparently incorrectly attributed to O. Ktze. by] Hanna, Am. F. Journ. 22: 6 (1932). *Pteridium aquilinum* (L.) Kuhn var. *lanuginosum* (Bong.) Fernald, Rhodora 37: 247 (1935), not (Bory ex Willd.) Kuhn (1879).

*Growing tip of the rhizome* usually with a tuft of dark hairs; *frond* 0.3–5 m., usually about 0.8–2 m. high, the taller fronds scandent, *vernation* subgleichenioid; *stipe* usually shorter than the blade; *blade* 0.2–4 m., usually about 0.6–1 m. long, usually ovate-triangular, less often pentagonal or ovate, not ternate, usually tripinnate or tripinnate-pinnatifid; *rachis* slightly to moderately pubescent; *pinnae* and *pinnules* subacute to obtuse; *pinnules* usually nearly or quite at right angles to the costa, sometimes somewhat at an oblique angle; *costules* usually slightly





FIG. 1, middle pinna of *PTERIDIUM AQUILINUM*, var. *FEEL*,  $\times \frac{1}{2}$ ; FIG. 2, upper pinna of var. *DECOMPOSITUM*,  $\times \frac{1}{2}$ ; FIG. 3, tip of middle pinna of var. *WIGHTIANUM*,  $\times \frac{1}{3}$ ; FIG. 4, upper half of middle pinna of var. *TYPICUM*,  $\times \frac{1}{2}$ .





FIG. 1, basal pinna of *PTERIDIUM AQUILINUM*, var. *LATIUSCULUM*,  $\times \frac{1}{3}$ ; FIG. 2, basal pinna of var. *PSEUDOCAUDATUM*,  $\times \frac{1}{2}$ ; FIG. 3, next to basal pinnule of a basal pinna of var. *AFRICANUM*,  $\times \frac{1}{2}$ ; FIG. 4, frond of variant of var. *LATIUSCULUM*,  $\times \frac{1}{6}$ ; FIG. 5, next to basal pinna of var. *PUBESCENS*,  $\times \frac{1}{3}$ .



to moderately pubescent beneath and less so above; penultimate segments often pinnatifid, less often pinnate or pinnate-pinnatifid; longest entire segment or entire part of a segment from three to five, usually about four, times as long as broad; *ultimate segments* usually straight, adnate or broadest at the base, the *upper surface* slightly to quite *pubescent*, at least near the margin, the midnerve usually glabrous, the *margin moderately pubescent*, the *lower surface* usually *densely pubescent*, less often slightly pubescent, rarely glabrous except along the midnerve; *fertile indusium* usually slightly *ciliate* and slightly *pubescent* on the outer surface, rarely becoming glabrous with age, *sterile indusium ciliate* and sometimes also pubescent on the outer surface, the *fertile* usually 0.25–0.3 mm. wide, rarely up to 0.5 mm. wide, the *sterile* 0.25 mm. or less wide, very rarely 0.4–0.5 mm. wide, the *fertile portion broader than the sterile* on the same segment.

TYPE: No type designated, specimens labeled by Underwood in the Herbarium of the New York Botanical Garden typify the variety.

TYPE LOCALITY: "Utah, California and northward."

Shade forms<sup>15</sup> approach var. *latiusculum* in having the sterile indusium glabrous or nearly so and the lower surface of the blade nearly glabrous, or in some cases more glabrous than in typical var. *latiusculum*—for example, *Merrill & Wilcox 923*, Wyoming; *Nelson & Nelson 6733*, Wyoming.

Intermediates between var. *pubescens* and var. *latiusculum* occur along the eastern border of the range of var. *pubescens*. Hanna<sup>16</sup> remarked that the Wyoming Bracken was "rather intermediate between the eastern *P. aquilina* [var. *latiusculum*] and the western *P. aquilina*, var. *pubescens* (Underw.) Kuntze." In a more recent article, on the ferns of Colorado where var. *latiusculum* also occurs, Wherry<sup>17</sup> says that "The relations be-

<sup>15</sup> In regard to ecological variation I think it is worthwhile to put on record the results of the following experiment. As part of the Carnegie Institution transplant experiments, the late Prof. Hall sent two plants of var. *pubescens* from Mather, California, to Mr. C. A. Weatherby at East Hartford, Connecticut. Mr. Weatherby received the plants in September, 1922, grew them successfully, and had them under observation until July, 1929. One plant was grown next to an unprotected east wall and the other by a fence, exposed to the sun for the greater part of the day. The reactions of the two plants were similar. The outline of the blade did not change and the segments did not become noticeably broader or thinner. The fronds grew to be six feet tall and dependent upon a support to remain erect. The only marked change was that the density of the pubescence gradually decreased so that in 1929 the plants were very noticeably less pubescent than when first received. The general differences between the Connecticut and California localities are a more humid climate, a lower elevation and about a four-degree higher latitude at the former.

<sup>16</sup> Hanna, Distribution of the Ferns of Wyoming. *Am. F. Journ.* **22**: 6 (1932).

<sup>17</sup> Wherry, Colorado Ferns. *Am. F. Journ.* **28**: 136 (1938).



tween these two Brackens need further study, for their intergradation in this region is so marked as to cast doubt on their specific distinctness." Some of the intermediates have the general characters of var. *latiusculum* except that they are pubescent beneath or have the pinnules set nearly at right angles to the costa. Others have an ovate blade and the sterile indusium slightly ciliate as in var. *pubescens* but are glabrous beneath except along the midnerve; or have the general characters of var. *pubescens* but have the pinnules at an oblique angle to the costa. Intermediate specimens are: Miller's Canyon, Huachuca Mts., Arizona, July 10, 1909, *Goodding* 170 (G, NY); San Francisco Mts., Arizona, Aug. 17, 1889, *Knowlton* 14 (G, US); Buckskin Mts., Arizona, June 30, 1909, *Tidestrom* 2336 (US); Central, New Mexico, Aug., 1895, *Mulford* 398 (NY); Rindoso Creek, Lincoln Co., New Mexico, July 1, 1895, *Mearns* (US); Buffalo Pass, Colorado, Aug. 11, 1898, *Shear & Bessey* (US); Southwest of Franktown, Douglas Co., Colorado, June 17, 1937, *Wherry* (US); Silver Reef, Utah, May 5, 1894, *M. E. Jones* 5176 (US); Gibbon Canyon National Park, Wyoming, *Carleton* 204 (F); Centennial Valley, Wyoming, Aug. 18, 1896, *Nelson* 2662 (NY).

Some specimens of var. *latiusculum* approach var. *pubescens* in characters of indusium and vestiture. A specimen from a burnt-over hillside, *Moore* 2221, West Virginia, is pubescent beneath between the margin and the midnerve and the fertile and sterile indusium is slightly ciliate and pubescent. The following specimens from New York, Ohio, Massachusetts and Indiana are pubescent beneath between the margin and the midnerve: Washington Co., New York, July 30, 1890, *Burnham* (Herb. Cornell U.)<sup>18</sup>; Otsego Co., New York, *Frost* (Herb. Cornell U.); Cleveland, Ohio, Aug. 15, 1875 (Herb. Cornell U.); Line Station, Indiana, Aug. 2, 1876, *Grassly* (F); Granville, Hampden Co., Massachusetts, Sept. 19, 1913, *Seymour* 60 (G).

An interesting phase, approaching var. *pubescens* in outline of blade and pubescence is discussed under var. *latiusculum*.

Var. *pubescens* differs from var. *latiusculum* in having the tip of the rhizome with a tuft of dark hairs rather than nearly

<sup>18</sup> I am indebted to Dr. R. T. Clausen for bringing to my attention this material in the Cornell University Herbarium.



naked, and an ovate-triangular, fairly evenly pinnate blade rather than a broadly triangular, ternate blade. Also the pinnales are nearly at right angles to the costa rather than at an oblique angle, the lower surface is densely pubescent between the margin and the midnerve rather than pubescent only on the midnerve and the fertile and sterile indusium is ciliate and sometimes also pubescent rather than glabrous. The frond is a little taller on the average and certainly reaches an extreme that var. *latiusculum* never approaches.

Var. *pubescens* differs from var. *typicum* in the pubescent rather than usually glabrous margin of the segments and the markedly less ciliate and pubescent fertile and sterile indusium. The penultimate segments are usually not as evenly pinnatifid or pinnate.

Var. *pubescens* is also closely related to vars. *Feei* and *decompositum* and the differences are discussed under those varieties.

In Michigan, Ontario and Quebec var. *pubescens* probably occurs as a pre-glacial relic on or related to local nunatak areas.<sup>19</sup>

Var. *pubescens* grows in pastures, open forests, burnt-over areas, on open slopes, in thickets, and in woods, in damp or dry places; mostly in the Transition and Canadian Zones, from sea level up to 3000 m.

It ranges from southern Alaska to Mexico, east to Wyoming, Colorado and western Texas; isolated eastward in South Dakota, northern Michigan, Bruce Co., Ontario and Megantic Co., Quebec.

ALASKA: New Metlapatla, July 5, 1895 (Herb. Field Mus. nos. 366780, 366786); Sitka, *Bongard* (G), isotype of *Pteris aquilina* var. *lanuginosa* Bong.; Sitka, Aug. 2, 1916, *J. P. Anderson* 263 (US); Heyder, June 25, 1924, *Whited* 1284 (US); McDonald Lake, July 15, 1921, *H. M. Smith* (US); Petersburg, July 3, 1918, *J. P. Anderson* 652 (NY).

DOMINION OF CANADA.—QUEBEC: Caribou Hill, Black Lake, Megantic Co., Aug. 26, 1915, *Fernald & Jackson* 11960 and 11961 (G). ONTARIO: Tobermory, Bruce Peninsula, July 28, 1933, *Krotkov* 6319 (US); Dunk's Bay, Tobermory, Bruce Co., Aug. 20, 1933, *T. M. C. Taylor* 6100 (G). ALBERTA: Vicinity of Banff, Aug. 29, 1899, *McCalla* 2434 (NY). BRITISH COLUM-

<sup>19</sup> See Fernald, *Critical Plants of the Upper Great Lake Region of Ontario and Michigan*. *Rhodora* 37: 247 (1935).